

Advanced management of separated root canal instruments in mandibular molars: bypass technique combined with diode laser irrigation

Penanganan lanjut dari instrumen saluran akar yang patah pada gigi molar rahang bawah: teknik *bypass* dikombinasikan dengan irigasi laser diode

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ABSTRACT

The bypass technique allows for optimal cleaning and shaping of the root canal around the fractured instrument, thereby increasing the chances of successful treatment. A 25-year-old woman came to RSGMP Unhas complaining of a lump on her lower right posterior gum and had undergone root canal treatment but it was not yet complete. Intraoral examination of tooth 46 revealed vitality test (-), percussion (-), and palpation (-) with a 3 mm diameter fistula on the lingual side. Radiographic examination of the fractured instrument showed widening of the periodontal ligament at the apical third of the mesial root canal. The initial diagnosis was incomplete therapy accompanied by chronic apical abscess. The patient was scheduled for endodontic treatment using the bypass technique. Root canal preparation was performed using the bypass technique with K-files numbered 8 to 20, followed by preparation using Protaper Gold F4 and disinfection with 5.25% NaOCl, as well as activation using a diode laser for 20 seconds in 3 cycles. Ca(OH)₂ was placed as a root canal medication for 2 weeks. Obturation was performed using the hydraulic condensation technique with a bioceramic sealer. The patient showed no symptoms and experienced stable improvement. Monitoring for 3 months is ongoing. It is concluded that the careful application of the bypass technique, supported by a diode laser, provides a reliable and effective method for addressing the challenge of fractured endodontic instruments.

Keywords: separated instrument, file bypass, effective irrigation

ABSTRACT

Teknik *bypass* memungkinkan pembersihan dan pembentukan saluran akar yang optimal di sekitar alat yang patah, sehingga meningkatkan peluang keberhasilan pengobatan. Seorang perempuan berusia 25 tahun datang ke RSGMP Unhas dengan keluhan benjolan pada gusi posterior kanan bawah dan telah menjalani perawatan saluran akar tetapi belum selesai. Pemeriksaan intraoral gigi 46 menunjukkan tes vitalitas (-), perkusi (-), dan palpasi (-) dengan fistula diameter 3 mm di sisi lingual. Pemeriksaan radiografi alat yang patah disertai pelebaran ligamen periodontal pada 1/3 apikal saluran akar mesial. Diagnosis awal adalah terapi yang belum selesai disertai abses apikal kronis. Pasien dijadwalkan untuk perawatan endodontik menggunakan teknik *bypass*. Persiapan saluran akar menggunakan teknik *bypass* dengan K-files nomor 8 hingga 20, dilanjutkan dengan persiapan menggunakan Protaper Gold F4 dan desinfeksi dengan NaOCl 5,25%, serta aktivasi menggunakan laser diode selama 20 detik dalam 3 siklus. Ca(OH)₂ ditempatkan sebagai obat saluran akar selama dua minggu. Obturasi dilakukan menggunakan teknik kondensasi hidrolik dengan sealer biokeramik. Pasien tidak menunjukkan gejala dan terjadi perbaikan yang stabil. Pemantauan selama 3 bulan masih berlangsung. Disimpulkan bahwa penerapan teknik *bypass* yang cermat, didukung oleh laser diode, memberikan metode yang andal dan efektif untuk mengatasi tantangan alat endodontik yang patah.

Kata kunci: instrument patah, *bypass file*, irigasi efektif

Received: 10 October 2025

Accepted: 15 November 2025

Published: 01 December 2025

INTRODUCTION

The incidence of instrument separation varies 2-6% of examined cases. The incidence of retained endodontic stainless steel hand instruments has been documented to vary 0.25-6%. The separation rate of NiTi rotary instruments ranged 1.3-10.0%. A fractured instrument in the root canal could block the apical endpoint due to various endodontic tools, including files, reamers, drills, or hand instruments.^{1,2} The factors responsible for this unfortunate occurrence have been identified. The structure of the root canal is a critical factor influencing the incidence of file fractures. Specifically, a decrease in the radius of the root canal's curvature elevates the probability of file fractures. It is commonly recognized that there exists a direct association between the quantity of endodontic files use and the potential of fracture.³ The treatment strategy for fractured files involves abstention, a conservative approach or orthograde technique, surgical intervention, and tooth extraction. Despite the existence of numerous procedures and technologies, there is no defined approach that is both safe and regularly effective for the retrieval of separated instruments.

The choice of management strategy is contingent upon case selection, risk assessment of success, prognosis of the treated teeth, clinical experience, and patient agreement.²

Endodontic instruments physically eliminate bacteria and infections or inflammatory pulp tissue from the root canal system and morphology the canal for enhanced and more efficient obturation. Instrumentation unable to remove all bacteria from the root canal, while it minimizes microbial load; therefore, chemical disinfectants are utilized to facilitate elimination the residual infected pulp tissue and germs within the dentinal tubules, along with irrigation. Sodium hypochlorite (NaOCl) is the primary disinfectant of root canal therapy due to its capacity to eliminate many diseases range of bacteria, but the dentinal tubules cannot be sterilized.^{4,5} *Enterococcus faecalis* is highly significant in the failure of endodontic therapy. Consequently, in instances of microbial resistance to traditional methods of treatment, lasers may serve as an adjunctive therapy. Method to exterminate and diminish germs. The superior antibacterial efficacy of diode laser irradiation is due to its enhanced penetration depth, re-

aching up to 1000 µm into dentinal tubules, in contrast to the limited penetration of chemical disinfectants, which is restricted to 100 µm. The diode laser is among the most prevalent lasers utilized in endodontics. Diode lasers are offered in four wavelengths: 810–830 nm, 940 nm, and 980 nm. The antibacterial properties of diode lasers belong to the thermal action and the elevation of temperature in root canals during exposure.⁵

CASE

A 25-year-old woman presented to RSGMP Unhas with a complaint of a lump on the lower right posterior gum and had undergone root canal treatment but it was not yet completed. Intraoral examination, tooth 46 showed vitality test (-), percussion (-), and palpation (-) with a fistula measuring 3 mm in diameter on the lingual side. Radiographic examination results showed a broken instrument accompanied by widening of the periodontal ligament in the apical third of the mesial canal. The diagnosis was previously initiated therapy accompanied by chronic apical abscess. The patient was scheduled for endodontic treatment using the bypass technique (Fig.1).



Figure 1a Clinical photograph, b initial radiograph

MANAGEMENT

The instrument circumvent method was implemented in the following manner; the fragment was attempted to be loosen with the #8 K-file by following the glide path of the mesiobuccal canal of 46. The file was then inserted slowly and carefully into the root canal, attempting to negotiate past the broken fragment of an instrument in between the dentinal wall and fractured instrument that was done to avoid placing the instrument directly on top of the broken file. The hand file was not removed at the time the hold was felt. We employed a #6 K-file to perform a gentle in-and-out movement, followed by a #8 K-file, while ensuring that the canal was adequately irrigated. Using a #10 K-file, we assessed the canal's patency at 20,5 mm from the coronal reference point (working length) on a radiograph. The risk of further instrument separation was mitigated by hand filing up to #20 K-file. The working lengths of all remaining canals were measured, and the chemomechanical preparation of all four canals was completed to a depth of 20.07%. In the mesiobuccal root canal, a place-pull, rotate, and withdrawal movement was implemented in conjunction with the extensive irrigation, as opposed to a filling motion (Fig.2).

The irrigation was conducted using normal saline, 5.25% NaOCl, and 17% EDTA. Bioceramic intracanal medicament was applied for a period of 2 weeks. The patient was discovered to be completely asymptomatic

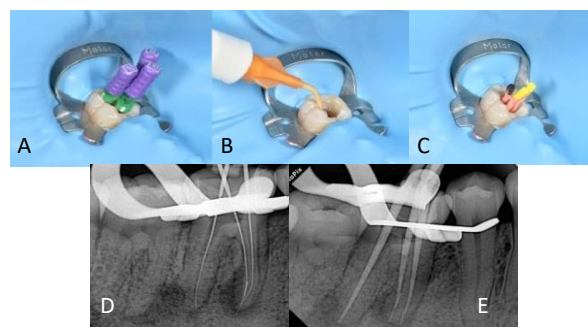


Figure 2a Working length determination, b application intracanal medicament, c try-in gutta percha cones, d radiography of working length determination, e radiography of try-in gutta percha cones

during the subsequent appointment. Subsequently, the root canals were sealed with a bioceramic sealer and a gutta-percha cone, utilizing a hydraulic condensation obturation technique (Fig.3). The final radiograph was obtained. After one week, the permanent restoration was completed. The patient was advised to return at 1, 6, and 12 months.

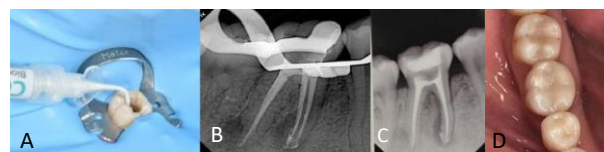


Figure 3a Working length determination, b root canal obturation, c after root canal obturation, d direct restoration

DISCUSSION

Radiographic evaluation, particularly with conventional periapical films, often presents a 2D representation of the complex root canal anatomy, potentially misrepresenting the true shape and curvature of the canals. Even seemingly straight canals on a radiograph can possess undetected curvatures due to the projection angle of the radiographic beam, which significantly complicates precise negotiation and increases the risk of instrument separation.⁶ Therefore, a thorough understanding of root anatomy, the application of diverse techniques and instruments are paramount for endodontists to accurately identify and manage curved canals effectively.⁷

Establishing a glide path with stainless steel hand files prior to using rotary nickel-titanium (NiTi) files is a critical step in mitigating the risk of instrument separation, especially in curved root canals.² This methodical approach facilitates a smoother passage for rotary instruments, thereby reducing the stress and fatigue on the files and consequently minimizing the likelihood of fracture.⁸ By creating a well-defined and expanded pathway, rotary files can navigate the canal's curvature with less resistance and force, promoting a higher success rate in endodontic procedures.¹

When instrument separation occurs during root canal therapy, a comprehensive clinical and radiographic assessment of the fragment is essential for determining the most appropriate course of action.³ Treatment decisions are influenced by several factors, including the vitality of the dental pulp, the extent of root canal infection, the specific anatomy of the root canal system, and crucially, the location, size, and type of the fractured instru-

ment, as well as the overall integrity of the remaining tooth structure.⁹ In certain clinical scenarios, opting to bypass the fractured fragment may be a more prudent approach, particularly if its removal poses a greater risk of further complications. This bypass strategy often aligns with the primary objective of root canal therapy, which focuses on adequate biomechanical preparation and subsequent obturation of the root canal system.¹⁰

The bypass technique offers a less invasive alternative to attempts at instrument retrieval and can be a viable option in specific circumstances.⁸ However, it is essential to acknowledge the potential risk of extruding the fractured fragment beyond the apex during the bypass procedure, which could lead to periapical inflammation and pathology.⁸ The decision to pursue a bypass technique versus instrument retrieval necessitates a meticulous evaluation of the fragment's characteristics, the complex root canal anatomy, and a thorough consideration of the potential benefits and risks associated with each treatment modality.^{9,10}

Furthermore, the integration of diode laser technology substantially enhances RCT outcomes by improving irrigation efficacy and delivering potent antibacterial effects.^{4,11} Diode lasers effectively eliminate residual bacteria in anatomically complex areas of the root canal system that are often inaccessible to conventional irrigation methods.^{5,12} This enhanced disinfection capability contributes significantly to the long-term success of RCT by minimizing microbial presence and reducing the potential for post-treatment infections.¹³

Beyond its antimicrobial properties, diode laser support also contributes to the preservation of root structure and minimizes tissue damage during root canal procedures.¹⁴ The precise energy delivery of the laser allows for targeted elimination of bacteria without compromising the integrity of the surrounding dentin, which is crucial for maintaining the tooth's structural strength.¹⁵ This conservative approach helps to ensure the longevity of the treated tooth and prevents complications that might arise from excessive removal of tooth structure.¹⁶

The combination of the bypass technique with diode laser support represents a sophisticated approach to managing separated instruments in root canals. This synergy capitalizes on the bypass technique's ability to navigate around obstructions while preserving root structure and the diode laser's capacity for thorough disinfection and tissue healing. The resulting treatment strategy aims for improved clinical outcomes, characterized by reduced post-operative discomfort, enhanced healing of periapical tissues, and ultimately, increased survival rates for compromised teeth.^{14,17}

It is concluded that the careful application of the bypass technique, supported by advanced diode laser technology, provides a robust and effective method for addressing the challenge of separated endodontic instruments. This comprehensive approach, which prioritizes the preservation of tooth structure, effective antimicrobial action, and optimal canal sealing, contributes significantly to achieving predictable and long-lasting clinical results in complex root canal.

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